

CHAPTER 5.000

WATER RESOURCE MANAGEMENT

5.100 PURPOSE/OBJECTIVES

- A. The purpose of this chapter is to establish minimum acceptable design criteria necessary to promote adequate drainage and limit adverse impacts upon the health, safety, and welfare of the general public and the County's water resources that may result from unregulated stormwater runoff and to set forth design criteria. An additional purpose is to assure compliance with relevant state and federal regulations. Adequate drainage must have the hydraulic characteristics necessary to convey stormwater runoff from the contributing watershed, or portion thereof, for a specified rainfall event. To meet these objectives, it is necessary for a detailed assessment of a given drainage area, stream geometry and health and the natural drainage shed hydrology prior to the development of a management plan required as part of a land development application.
- B. The design of an adequate drainage system must (a) account for both off-site and on-site stormwater runoff; (b) honor natural drainage divides; and (c) convey stormwater runoff and discharge into an adequate channel. An adequate channel shall be defined as a natural or man-made channel or pipe which can convey the stormwater runoff without overtopping its banks, surcharging the system, or creating erosive velocities. (Reference Virginia Erosion and Sediment Control Handbook - Minimum Standard MS-19.) Adequate drainage must also include provisions for overland relief to accommodate stormwater runoff in excess of the design storms without damaging or endangering adjacent structures or properties.
- C. Proposed drainage systems which are designed to convey concentrated off-site stormwater runoff across the project site shall be located within a drainage easement dedicated to the County of Loudoun. Regulatory floodplain limits as defined by the Zoning Ordinance shall be contained within an easement dedicated to the County of Loudoun.
- D. Stormwater management facilities shall be provided in conjunction with proposed development, where an adequate outfall channel does not exist, in accordance with the criteria contained in this chapter. Stormwater management facilities serving single or multiple properties, sites or drainage areas may be incorporated within proposed developments. Regional stormwater management provisions shall be followed in accordance with any County approved drainage districts.
- E. The objective of the County of Loudoun is to promote water quality provisions within the drainage system design of all proposed developments as contained in this chapter. Best Management Practices (BMP) measures address the water quality impact of urbanization on the surface and groundwater resources of Loudoun County without the necessity for extensive water quality monitoring and/or inspections.

- F. The floodplain management criteria specified within the Loudoun County Zoning Ordinance are based on a formal determination of the regulatory flood elevations. Detailed floodplain studies shall be prepared in accordance with the criteria contained within this chapter.
- G. Any development activity that is commenced or is conducted contrary to this chapter or the approved plans and permit, may be subject to the enforcement actions outlined in the Virginia Stormwater Management Handbook and the Loudoun County Codified Ordinance.

5.200 DESIGN STANDARDS

Except where specifically supplemented herein, the design provisions of the most current adopted VDOT Drainage Manual, Virginia Erosion and Sediment Control Handbook, Virginia Stormwater Management Handbook, and all other reference documents referred to herein, at the time of application acceptance shall apply in all cases.

Low-impact design practices may be incorporated into drainage designs. Low Impact development is a design approach that seeks to minimize the impact of development on watershed characteristics by reducing impervious areas and creating opportunities for ground water recharge, evaporation, and vegetation absorption in an effort to mimic the predevelopment hydrologic conditions. This can be accomplished by minimizing the concentration of runoff, utilizing vegetative filtration practices, conservation of natural features, and utilizing practices such as small scale controls, directing run-off to natural areas, customized site design and maintenance, pollution prevention, and education. “Low-Impact Development Design Strategies: An Integrated Design Approach”, dated July, 1999 and prepared by Prince George’s County, Maryland Department of Environmental Resources is the recommended reference for this design alternative or other design standards as approved by the Director. The low-impact drainage design within residential developments shall also meet the open channel specifications, as set forth in this chapter. The Director shall publish additional guidelines regarding low impact design practices.

5.210 HYDROLOGIC DESIGN

All hydrologic parameters shall be based on the current zoning or adopted planned land use for the watershed, whichever represents the most intense use. Adopted planned land use is defined as approved comprehensive plans, as amended, and/or zoning map, as amended. The following methodologies are acceptable.

- A. The hydrologic methodologies outlined in the Virginia Stormwater Management Handbook are acceptable.
- B. HEC-1 Model or HEC-HMS Model utilizing Natural Resources Conservation Service rainfall runoff relationship.

C. Other methods are subject to approval by the Director.

For rainfall intensity and rainfall depth values, use the following tables:

Table I

COUNTY OF LOUDOUN RAINFALL INTENSITY VALUES TIME OF CONCENTRATION						
Storm Event	5 min.	10 min.	15 min.	30 min.	60 min.	120 min
100 year	9.42	7.44	6.30	4.58	3.22	2.23
50 year	8.61	6.79	5.72	4.09	2.82	1.89
25 year	7.74	6.15	5.19	3.67	2.47	1.61
10 year	6.75	5.36	4.50	3.13	2.05	1.29
5 year	6.05	4.78	3.99	2.75	1.78	1.11
2 year	5.01	4.00	3.35	2.28	1.42	0.83
1 Year *	4.15	3.29	2.73	1.86	1.15	0.68

*Per Tech Memo October 21, 2009

Table II

RAINFALL DEPTH		
1 year	24 hour rainfall	2.53"
2 year	24 hour rainfall	3.05"
5 year	24 hour rainfall	3.89"
10 year	24 hour rainfall	4.61"
25 year	24 hour rainfall	5.70"
50 year	24 hour rainfall	6.64"
100 year	24 hour rainfall	7.70"

5.220 HYDRAULIC DESIGN

This section identifies specific criteria for the design of all drainage systems including sizing, hydraulic performance, easement requirements, pipe materials, etc. Design flows will be determined utilizing methods discussed in this chapter and the drainage system will be sized to collect and/or convey the design flow at all points along the system.

A. General Design Criteria

1. Proposed storm drainage systems shall be designed to convey the runoff from a 10-year rainfall when its intended use is to function as the primary drainage system. The primary drainage system consists of storm sewers, culverts, and open drainageways designed to convey concentrated runoff to adequate channels. The primary system does not include overlot grading and other minor conveyance swales. At sump locations on public roads with curb and gutter a 10' wide drainage easement is required for overland relief. The easement shall extend from the public street to the rear property line of lots abutting the street.
2. Drainage systems shall not be terminated at the project boundary unless an adequate channel exists at that point, as defined in this chapter.
3. Drainage systems shall be designed to provide, as a minimum, overland relief for the 100-year rainfall without increasing the flood potential for nearby buildings. Calculations shall be provided to show appropriate overland relief when the primary drainage system is adjacent to the buildings. In lieu of calculations, the plans must indicate at least a minimum of 1 foot of overland relief being provided between the relief point and the lowest entry point of any building.

B. Storm Sewers/Culverts

1. Drainage design computations, as required by VDOT's Drainage Manual, will be submitted with all Construction Plans and Profiles and/or Site Plans containing storm sewer or culvert drainage systems.
2. The storm sewer and culvert designs shall include the following:
 - a. Construction information, including invert elevations, in and out; size; type of pipe; gauge or class; length and percent of slope.
 - b. Storm sewer appurtenances shall be identified by type and number (i.e., #00, MH-1, or MH-1 #2), including number and length of throats and locations.

3. Capacity of storm sewer pipe shall be determined by the Manning formula, which is expressed as:

$$Q = va = (1.49/n) r^{2/3} S^{1/2} a$$

Q = Quantity of flow in cubic feet per second

v = Velocity of flow in feet per second

a = Required area in square feet

n = Coefficient of roughness (0.013 for concrete pipe)

r = Hydraulic radius in feet =
cross sectional area of flow ÷ wetted perimeter

S = slope of pipe in feet per foot

4. Culvert pipe sizes shall be determined in accordance with Hydraulic Design Series No. 5, Federal Highway Administration, Department of Transportation, or other VDOT-approved method.
5. Minimum size of concrete pipe to be used outside of the public right-of-way will be 12 inches in diameter, where the distance between access openings is less than 50 feet. The minimum size of pipe permitted within the public right-of-way is 15 inches, unless otherwise specified in the VDOT Drainage Manual.
6. There may be no reduction in pipe size greater than one standard increment along the direction of flow within a storm sewer system.
7. The minimum cover for all drainage pipes within public or private Category A and B roadways (street) rights-of-way shall be 2 feet, or one-half the diameter of the pipe, whichever is larger. When the storm sewer pipe is laid outside the street right-of-way or within Category C roadways, a minimum of 2 feet of cover shall be required. For Low Impact Design in non-load bearing conditions, a minimum of 1 foot of cover may be provided. If the minimum cover requirements as set forth in this section cannot be met, then stronger pipe classifications may be submitted for approval. Minimum cover for single residential lot driveways shall conform to VDOT standards.
8. Storm sewers shall be designed to provide a minimum velocity when running full of no less than 2 1/2 feet per second. Pipe velocities shall not exceed 20 fps. Pipe velocities within the public right-of-way shall comply with the VDOT Drainage Manual.

9. Except where noted otherwise, the maximum length between access openings shall be 300 feet for pipes less than 36 inches in diameter or 500 feet for pipes 36 inches in diameter or greater. An access opening may be an inlet, manhole, junction box, or other approved appurtenance.
10. The minimum slope of each segment of the storm sewer lines shall be 0.5%.
11. The need for concrete anchors must be investigated on storm sewer lines with slopes of 20 percent or greater. If anchors are required, the design engineer will show a detail on the plans with spacing requirements.
12. Storm sewer pipes larger than 15 inches in size shall not outfall in the front yard of a single family detached lot less than or equal to 20,000 sq. ft., but should be extended at least to the rear property line. Storm sewer outfalls located in single family attached developments shall extend at least to the rear lot line. If the storm sewer outfalls on a lot, or adjacent to a lot, on which an existing building will remain, sufficient topographic information shall be provided to verify overland relief.
13. The ends, entry or exit, of any storm sewer system and/or culvert shall be provided with a standard end wall, head wall, curb inlet, yard inlet, flared end section, or other appurtenance or structure suitable for the intended use of the facility.
14. Erosion protection shall be provided at the outlets of storm sewers and culverts based on outlet velocity in accordance with the following:
 - a. 2 fps to 5 fps Velocity

Sod protection (Kentucky Blue Grass or equally erosion resistant sod or other material) or VDOT, Class I Dry rip-rap or current equivalent*.
 - b. 5 fps to 8 fps Velocity

VDOT Class I dry rip-rap or current equivalent*. Length of rip-rap to be determined in accordance with the Virginia Erosion and Sediment Control Handbook.
 - c. 8 fps to 18 fps Velocity

VDOT Class II dry rip-rap or current equivalent*. Length of rip-rap to be determined in accordance with the Virginia Erosion and Sediment Control Handbook.

d. Velocities in Excess of 18 fps

Special design energy dissipaters or impact basins shall be required. The design of these structures must meet the approval of the County and/or VDOT.

*The use of natural rock located on the subject development site is encouraged when the equivalency requirements can be met.

15. Level spreaders may be used to promote sheet flow across vegetated areas in lieu of channelization. The following design criteria shall be followed when utilizing level spreaders for this purpose:

a. The schematics depicted in Figures 1 and 2 shall be utilized. Other equivalent design configurations may be used subject to approval by the Director.

b. The maximum stormwater discharge to level spreaders for the 10-year design storm must be limited to the following:

1. Simple Level Spreader – 15 cfs

2. Level Spreader with Plunge Pool – 35 cfs

c. The maximum distance that discharge from a level spreader may be considered to remain in sheet flow before reaching a stable outlet is 150 feet. To inhibit the re-concentration of flows, the average slope over the entire length of the sheet flow shall be no greater than 8%.

d. Level Spreaders adjacent to storm sewer pipe outfalls shall not be located any closer to the invert out of the pipe than the length of required outlet protection.

e. A level spreader that receives discharge from storm sewer within the VDOT right-of-way is subject to these additional constraints:

1. An effort shall be made to provide a minimum 1 foot vertical clearance between the invert out of the storm sewer and the top of the level spreader.

2. If a 1 foot vertical clearance between the invert out of the storm sewer and the top of the level spreader cannot be achieved due to topographic or other site constraints, evidence of positive relief for the 10-year storm without restriction to the hydraulic function of the storm sewer shall be provided.

- f. In order to apply stormwater pollutant removal credit to the vegetated area below the level spreader, the area must meet the requirements for a “vegetated filter strip” as defined in the Virginia Stormwater Management Handbook. In such an application, the entire vegetated filter strip, defined by the length of the level spreader lip and extending to a stable outlet, shall be located within an easement that ensures the protection of the water quality BMP.

C. Open Channel Flow

1. Open channel is defined as a natural or manmade open drainageway. All open channels shall comply with the following table:

	On lots $\leq 20,000$ sq. ft.	On lots $> 20,000$ sq. ft.	On non-residential and common areas
Max. allowable flow*	2 cfs	No max., but if > 2 cfs, open channel should be 50 feet from rear of house and 10 feet from side of house.	No Requirement (NR)
Max. velocity*	4 fps	4 fps without armor.	4 fps without armor.
Min. average slope*	2 %	2%	1 %
Max. width of flow*	10 feet	NR	NR
Max. depth of flow*	12 inches	NR	NR
Preserved natural open channel > 2 cfs.	Allowed within easement	Allowed within easement	Allowed within easement

* in manmade open channels only.

Modifications may be approved by the Director to achieve low impact development design.

2. Open channels located inside the public right-of-way shall be designed and constructed in accordance with the VDOT Drainage Manual. The computations and the ditch cross-section shall be submitted with the plan and profile sheets.
 3. Open channels conveying over 2 cfs should be designed for stable, subcritical flow. Local depressions or flat slopes may be allowed along the flow path as part of low impact development design as long as they are designed to dissipate within 48 hours, unless designed for water retention.
- D. Overlot grading plans shall be provided within construction plans and profiles and grading permit applications for single family detached and attached developments for any lot less than one acre in size. The plan shall illustrate how house and lot grading will be integrated into the overall drainage system proposed for a particular section of development and shall honor drainage divides used for the drainage design. For the

purpose of supporting the proposed drainage design, a building footprint shall be illustrated on the individual lots which maximizes the development potential of the lot and specifies the minimum finished floor elevations for a given lot. The footprint should accommodate the potential models without impact to the proposed drainage design and patterns. Overlot grading plans are subject to the following:

1. Maximum yard grades for grass stabilized slopes shall be no steeper than 3:1. Steeper slopes must be stabilized with ground cover materials that do not require regular mowing. These plantings will need to be shown on the landscaping plan and reflected in the performance bond.
2. Yard overlot surface drainage in excess of 2 cfs (10 year design) should not be directed to overtop the curb and gutter of public or Category A private roads.
3. Such residential yards shall be graded so as to achieve flow from the house foundation to the point of any intended retention area or receiving drainage system by providing 6 inches of fall for the first 10 feet and, thereafter, a minimum average grade of 2%. This minimum average grade may be waived to decrease the area of disturbance and to promote tree conservation if it is demonstrated that positive drainage on the residential lot can be otherwise achieved. Local depressions or flat slopes may be allowed along the flow path as part of low impact development design as long as they are designed to dissipate within 48 hours, unless designed for water retention.
4. An overlot grading plan shall identify, at a minimum, the following proposed and existing elements:
 - a. House type or model and its distance to the 3 nearest lot lines;
 - b. Options to house that extend the foundation or garage slab;
 - c. Driveway location, grade, and width;
 - d. Elevations for the basement floor, first floor, and garage slab;
 - e. Topography with 2-ft contour intervals;
 - f. Limits of clearing and grading, tree save areas, floodplains, wetlands, or conservation easements;
 - g. Open channels;
 - h. Easements;
 - i. Areaways with top elevations;
 - j. Lot lines; with the corners highlighted by circling the corner.
 - k. Retaining walls shall be indicated and provided with the elevations proposed for the top of wall and bottom of wall.
 - l. Existing topography and structures on adjacent properties within 50 feet of lot lines;

The overlot grading plan should be scaled at a minimum of 1" = 30'; shall be prepared on 8-1/2" x 14", 11" x 17", or 24" x 36" sheets; and may depict lots

that are not part of the subject application.

- E. Overlot grading plans for lots over one acre in size may be provided using a typical lot layout versus illustrating each lot individually on the construction plans and profiles and subsequent grading permit application. However, the ultimate limits of clearing and grading for the individual lot development plans, to include the driveway, drainfield and potential house location, must be provided for review and approval as part of the construction plans and profiles or grading permit application.
- F. For any lot less than 1 acre in size, a location plat is required prior to requesting the framing inspection. A minimum of 6 weeks prior to occupancy, the builder must submit the location plat, stamped and signed by a licensed land surveyor or civil engineer, to the County Engineering Division, depicting the following as-built conditions: building setbacks, basement or lowest floor and garage slab elevations, and driveway grade (percent of grade from garage slab to back of driveway apron, or approximate grade if apron is not constructed). This information may be compiled as early in the construction process as practical and may be shown on the House Location Survey/Wall Check Plat, typically prepared on 8 1/2" x 14" sheets. The building permit number must be indicated on the location plat. Upon review and approval by engineering staff, the framing inspection may be requested and scheduled.
- G. Easements shall be required in accordance with Section 5.100.C and as further specified in this chapter.
 - 1. Standard minimum easement width shall be determined as follows with minimum easement width to be based on the width of the trench necessary to unearth the pipe. The trench width shall be based on a 1:1 slope from the edge of the trench. Where multiple pipes or pipe sizes larger than 72 inches are installed, the edge of easement shall be a minimum of 5 feet clear of the outside edge of the outermost pipe. Criteria resulting in the greatest width shall be used.

<u>Pipe Size</u>	<u>Minimum Easement Width</u>
Up to 18 inches	10 feet
21-33 inches	15 feet
36-48 inches	20 feet
54-72 inches	24 feet

- 2. Easements shall be extended to the property line and to an adequate channel. Easements shall be extended beyond the property line to provide for off-site drainage improvements. If flows leaving the property have increased then an off-site drainage easement shall be provided, unless such increased flows have negligible impacts.

3. For open channels, easement width shall generally be based on the width required to carry the design flow plus 5 feet on each side. Open channels will be in a minimum drainage easement of 15 feet.
4. Drainage easements shall be provided where drainage in an open channel exceeds 2 cfs. For an open channel draining runoff across more than two full residential lots, a drainage easement shall be provided where the open channel enters the third lot.
5. Easements are required to completely encompass the 10-year ponding area at all culverts and inlets, except that, where existing drainage structures are being improved, off-site easements on property not owned or controlled by the applicant shall not be required. Where the storm drainage easement for such culvert or inlet is a temporary easement, the ponding area easement may also be temporary.

H. Pipe Materials

1. All pipe used for the construction of drainage systems and/or stormwater management facilities shall be concrete or High Density Polyethylene (HDPE), as specified below. HDPE pipe is permitted in any particular application if VDOT approves its use, design and specifications during their review of the CPAP or Site Plan. Alternate materials can be utilized where specifically permitted below or in accordance with waivers granted by the Director of Building and Development.
 - a. All concrete pipe shall be a minimum Class III. All HDPE pipe shall meet the most recently published VDOT specifications. Alternate materials, where permitted, shall meet the current VDOT requirements.
 - b. Metal and/or other plastic pipe may be designated for use on-site where the facility is not located within an easement. All construction and use of these materials must be accomplished in accordance with manufacturer's recommendations.
 - c. HDPE pipe shall not be permitted in pond embankments

5.225 STORMWATER MANAGEMENT - GENERAL CRITERIA

A. General Criteria

1. Stormwater management facilities may consist of either above grade or underground facilities; however, underground facilities are permitted only within non-residential areas or high-density residential zones. Above grade stormwater management facilities may be designed as either wet or dry

facilities.

2. Stormwater management facilities serving single or multiple properties, sites, or drainage areas may be incorporated within proposed developments.
3. Regional stormwater management is defined as facilities and/or design criteria identified in a County approved drainage district study to control increases in runoff from developed sites within the established district. Stormwater management requirements identified with these studies must be met in conjunction with any applicable land development activity.
4. All stormwater management facilities must be located within an easement (i.e., 10 feet from the toe of slope and/or periphery). Such facilities shall be maintained by the landowner, an owners or homeowners association, or other legal entity approved by the Board of Supervisors, to the extent not maintained by the County pursuant to Chapter 1096 of the Codified Ordinances of Loudoun County (LCCO). Maintenance responsibilities shall be established in the required Deed of Dedication, in a form acceptable to the County Attorney.
5. Low-impact development design techniques **may** be incorporated into stormwater management designs.
6. Regular maintenance is vital to the proper functioning of stormwater management facilities. Designs shall consider and address the future operation and maintenance requirements of stormwater management facilities.
 - a. All required access-ways and easements shall be designated on plans and cleared, graded, or constructed with the facility construction.
 - b. Proximity of facilities to the public right-of-way shall be considered in order to minimize the length of the access-way.
 - c. Multiple access paths to major facilities should be provided.
 - d. Specifically delineated access easements may be required where stormwater management facilities are surrounded by residential lots.
7. All stormwater management retention ponds (wet ponds) that are not subject to a separate negotiated stormwater maintenance agreement with the County pursuant to Chapter 1096 of the LCCO must be periodically maintained and inspected by the property owner or HOA in accordance with the Virginia Stormwater Management Handbook. Such maintenance may include removal of silt, litter and other debris from all catch basins, inlets and drainage pipes, grass cutting and vegetation removal, and necessary replacement of landscape vegetation and any repair or replacement of structural features. The legal documents recorded to grant the easement for the stormwater management facilities must provide for

an annual inspection and report in accordance with Chapter 1096 of the LCCO.

8. When outfalls from stormwater management facilities are discharged to a receiving channel, energy dissipators shall be placed at the outfall as necessary to provide a stabilized transition from the facility to the receiving channel.

B. Facility Design Standards

1. Where required by previous approvals, Preliminary Stormwater Management Plans prepared in conjunction with proposed development shall include the following information:
 - a. General location of proposed centralized stormwater management facilities shown on available topographic mapping.
 - b. Drainage area delineation and computations for each facility.
 - c. Preliminary calculations to identify sizing criteria.
 - e. Proposed phasing of facility construction in conjunction with development phasing.
2. Computations submitted with detailed designs for proposed stormwater management facilities shall include the following information:
 - a. Stage - storage relationship for the facility.
 - b. Stage - discharge relationship for the proposed outfall structure(s) including computations.
 - c. Routing program utilized (may not be applicable in conjunction with facilities designed using previously approved graphical and/or short cut methodologies).
 - d. Hydrologic computations as outlined in this chapter.
3. All dry stormwater management facilities shall incorporate appropriate provisions for low flow conveyance without using concrete trickle ditches.
4. Underground Stormwater Management Facilities – Design of Underground Stormwater Management Facilities including water quality inlets will include the following information:
 - a. For structures that rely on soil suitability, a geotechnical report shall be provided which addresses the soil suitability, compatibility with materials

- to be used, and pH and corrosiveness of the soil and water runoff from the drainage area.
- b. Demonstrate that the facility will meet all stormwater management regulations of this chapter.
 - c. Detailed description and specifications of the facility, how the facility will be constructed or installed, and the manufacturer's and/or designer's recommendations for maintenance and maintenance schedule shall be provided.
5. The following information shall be included with designs for dam embankments related to stormwater management or recreational water impoundments.
- a. A geotechnical report shall be provided which addresses the soil seepage through the embankment and body of the pond, contains an embankment design, and addresses the soil and water pH and erosiveness related to the principle spillway pipe materials.
 - b. No landscape plantings other than grass or groundcover shall be proposed on the dam embankment.
 - c. The pond outfall shall be far enough from the property line to achieve an adequate transition in accordance with the Virginia Stormwater Management Handbook and the Virginia Erosion and Sediment Control Handbook.
 - d. Low-level drains shall be provided for wet ponds to facilitate maintenance and sediment removal where a gravity outfall is available.
 - e. Pond structures shall be engineered to assure structural integrity during the 100-year storm event.
6. The State Water Control Board regulates certain impounding structures defined therein (see Virginia Dam Safety Act, Title 10.1, Chapter 6, Article 2 of the Virginia Code and Dam Safety Regulations of the Virginia Water Conservation Board – (the Act)). The design criteria presented below apply to impounding structures (wet ponds) which have a height greater than or equal to 6 feet and are governed by the Virginia Dam Safety Act. In addition, the design criteria presented below apply to impounding structures which have a height greater than or equal to 15 feet. These impounding structures will conform to all design criteria listed in Chapter 5 of "Impounding Structure Regulations", Regulation No. 9, State Water Control Board, Commonwealth of Virginia.
- a. The height of the dam (H_d) is defined as the vertical distance from the

foundation to the water surface elevation plus freeboard allowance for wind setup, waves, and frost action.

- b. A slope stability analysis will be performed to address seepage through the structure, pore water pressure within the structure, slope pressure, and slope protection.
- c. Emergency spillways will be designed to pass at minimum a 100 year storm with the primary spillway assumed to be 100% clogged without endangering the integrity of the impounding structure.
- d. A maintenance program will be provided to the Department of Building and Development and implemented in conformance to "Safety Evaluation of Small Earth Dams", 2nd Ed., Natural Resources Conservation Service, Virginia Department of Conservation and Historic Resources.
- e. An Emergency Action Plan, as defined in the Act, will be submitted and maintained by the owner of the dam. The owner will be responsible for notifying the 24 Hour Dispatch Center at "911".

5.230 STORMWATER MANAGEMENT - WATER QUANTITY CRITERIA

Adherence to the Virginia Stormwater Management Handbook and the Virginia Erosion and Sediment Control Handbook shall be required. Exceptions shall meet the intent and spirit of the aforementioned handbooks.

A. General Requirements

1. Stormwater management facilities shall be provided in conjunction with land development activities, which require the submission of Construction Plans and Profiles or a Site Plan, where an adequate receiving channel for site runoff does not exist or cannot be provided. Stormwater management designs shall attenuate the post-development peak runoff rate from the one-year storm, the two-year storm, and the ten-year storm, considered individually, so as not to exceed the respective pre-development runoff rate. Additional peak flow attenuation of the design storm may be required if the receiving channel, culvert, or storm sewer within the public right-of-way does not meet the design criteria as defined in the VDOT Drainage Manual.

Concentrated stormwater runoff leaving a development site shall be discharged directly into a well-defined natural or constructed off-site receiving channel or pipe. A receiving channel must have a defined bed and bank.

An easement shall be provided where concentrated stormwater runoff is discharged from a development site onto an adjacent site in an area that

experienced only sheet flow runoff prior to the development of the subject site. This standard applies whether or not there has been an increase in the peak flow rate.

Offsite stormwater management facilities may be used to meet the requirements of this section where (1) it can be demonstrated that the facility was designed to accommodate the subject area, and (2) an approved maintenance and easement agreement with the facility owner is signed and recorded that comports with the provisions of Chapter 1096 of the LCCO.

Adequate channel must be demonstrated for every discharge point where there is an increase in velocity or peak runoff rate. A receiving channel or pipe is considered adequate if any of the following conditions can be met through an analysis of representative channel sections and/or pipe analysis.

- a. The bankfull capacity of the natural receiving channel is sufficient to pass an increased post development peak flow from the 2-year frequency storm and the channel velocity (2-year frequency storm) does not exceed the permissible (non-erodible) velocity of the channel lining. In addition, overbank flow for the 10-year storm must be conveyed within a recorded drainage easement.
- b. The bankfull capacity of the manmade receiving channel is sufficient to pass the post development peak flow from the 10-year frequency storm and the channel velocity (2-year frequency storm) does not exceed the permissible (non-erodible velocity of the channel lining.)
- c. The 10-year frequency storm is contained within the receiving culvert and/or storm sewer system.
- d. The contributing drainage area of the development site is less than 1 % of the total drainage area to the point of consideration in the channel or pipe.
- e. There is no increase in the velocity or peak runoff rate for the 2-year frequency storm (for natural receiving channels) or the 10-year frequency storm (for manmade receiving channels) at the point of discharge after development.
- f. The receiving channel is the main channel within a major floodplain as shown on the Floodplain Map of Loudoun County, that being a channel receiving runoff from an upstream area exceeding 640 acres.
- g. The amount of increase in runoff, calculated as the difference between pre-developed and post-developed peak discharge, leaving the subject

site represents less than one percent (1%) of the total design-storm discharge for the receiving channel or storm drainage system. For purposes of analysis, the total discharge in the downstream channel should be determined using existing conditions for watershed areas other than the subject site, which contribute to the total flow in the downstream channel.

2. Determination of flooding and channel erosion impacts to receiving streams due to land development projects shall be measured at each point of discharge from the development project and such determination shall include any runoff from the balance of the watershed which also contributes to that point of discharge.
3. The specific design storms shall be defined as either a 24-hour storm using the rainfall distribution recommended by the Natural Resources Conservation Service when using these methods or as the storm of critical duration that produces the greatest required storage volume at the site when using a design method such as the Modified Rational Method. Pre-development and post-development runoff rates shall be verified by calculations that are consistent with good engineering practices.
4. For purposes of computing runoff, all pervious lands in the site shall be assumed prior to development to be in good condition (if the lands are pastures, lawns or parks), with good cover (if the lands are woods), or with conservation treatment (if the lands are cultivated), regardless of conditions existing at the time of computation, unless an engineered on-site analysis indicates different conditions and is included with the plan submission.
5. Stormwater runoff shall be considered to be in a sheet flow condition where the maximum contributing length of flow is 150 feet for pervious surfaces and 75 feet for impervious surfaces.
6. The adequate outfall analysis, as required in this chapter, must be carried downstream for a sufficient distance to demonstrate that the receiving channel and/or pipe system has adequate capacity. Applicants are encouraged to provide photographs of the outfall channel existing conditions to support the adequate outfall analysis. In order to confirm an adequate outfall the following narrative analysis shall be provided and shall contain the following information:
 - a. The maximum allowable velocity in each stream segment must be determined based on the soil type and channel sinuosity in accordance with Chapter 5 of the Virginia Erosion and Sediment Control Handbook. The soil type, sinuosity, and maximum allowable velocity for each stream segment must be clearly described in the adequate outfall analysis.

- b. From the site discharge point to the channel of the minor floodplain:

From the site discharge point to the stream channel of the minor floodplain, detailed adequate channel calculations with field surveyed channel, pipe and/or culvert sections shall be provided.

The plan should include enough representative cross sections to evaluate the capacity of a receiving channel along its entire length. Manmade channels with a uniform section may only require one representative cross-section. At a minimum, cross-sections shall be provided every 50 feet within the first 150 feet and wherever there is a reasonably substantial change in stream geometry, roughness coefficient or slope. Non-uniform channels may require analysis of several cross-sections, particularly at constrictions or at changes in the flow characteristics. For piped systems, all pipe segments must be analyzed and if the potential exists for surcharge of the system, a hydraulic grade line must be provided for the piped system.

Engineering information from previously approved plans or record drawings (if available) may be used where it can be demonstrated that the assumptions and flow parameters used to design or analyze the downstream system are still valid.

- c. From the stream channel of the minor floodplain to the stream channel of the major floodplain:

An adequate outfall narrative and schematic shall be provided from the receiving channel of the minor floodplain to the receiving channel of the major floodplain. The schematic shall be taken from the Loudoun County Geographic Information System and shall include at a minimum parcels, buildings, drainageways, road crossings, and floodplain limits and will be supplemented with more current construction information as necessary.

A visual inspection of the receiving channel conditions shall be performed and documented in the adequate outfall narrative and schematic. The visual inspection narrative shall include an evaluation of the existing stream channel conditions, storm drainage system, culverts, structures, and critical areas. Critical areas which could potentially impact offsite properties or structures shall be addressed.

Adequate outfall calculations shall be provided using Loudoun County topographic information or, aerial or field topography where available, and approved plan information (where available) if the potential exists for a negative offsite impact. Onsite stormwater management or

adequate channel shall be provided if adequate channel cannot be demonstrated from the above exercise.

7. Stormwater management facilities shall not be required where adequate channel can be provided through on-site and/or off-site improvements. The drainage improvements (i.e. open channel, storm sewer, culverts, etc.) must be extended to an existing adequate channel.
8. Stormwater management requirements may be met through a combination of channel improvements, stormwater detention or other measures adequate to protect against downstream erosion.

5.300 STORMWATER MANAGEMENT - WATER QUALITY CRITERIA

5.310 WATER QUALITY DESIGN GUIDELINES

For any land development or redevelopment requiring construction plans and profiles or a site plan, stormwater runoff shall be controlled in accordance with the requirements of the Virginia Stormwater Management Handbook by the use of best management practices (BMP) that achieve the following general goals:

- A. To promote and preserve water quality, land disturbance shall be limited to the building footprint area and that area necessary to provide for the proposed use or development.
- B. Prior to initiating grading or other on-site activities on any portion of a lot or parcel, all associated permits required by federal, state, and local laws and regulations shall be obtained and evidence of such submitted to the County.
- C. Discharge of stormwater pollutants to wetlands shall be minimized, except where constructed wetlands are used as a BMP and are designed in accordance with County standards.
- D. Ingress and egress during construction shall be limited to one access point, unless otherwise approved by the County.
- E. Indigenous vegetation and tree cover shall be preserved to the maximum extent possible consistent with the use and permitted development and in accordance with the Virginia Erosion and Sediment Control Handbook and Chapter 7 of the FSM.
- F. Development shall maximize the use of sheet flow through vegetated areas and shall maximize the flow length through vegetated areas. Areas of concentrated development shall be located in upland areas and away, to the maximum extent practicable, from surface waters and drainageways.
- G. Compliance with the water quality criteria may be achieved by applying the performance based criteria or the technology based criteria as found in the Virginia Stormwater Management Handbook.

- H. Infiltration practices such as bio-retention, infiltration trenches, and rain gardens shall be allowed only where it can be demonstrated that soil conditions are favorable, or if an adequate under-drain is included in the design.

5.320 WATER QUALITY DESIGN STANDARDS

- A. Best Management Practices (BMP) measures shall be incorporated into the design of all Construction Plans and Profiles or Site Plan submissions, except as noted in this section, to achieve the following:

1. For development, the post-development nonpoint source pollutant load shall not exceed the pre-development load. For the purpose of calculating the pre-development pollutant load, an average land cover condition of 16 percent impervious cover shall be used.
2. For redevelopment sites, the nonpoint source pollutant load shall not exceed the greater of (a) the pollutant load, based on existing conditions, minus 10 percent; or (b) the pollutant load based on an average land cover condition of 16 percent impervious cover.
3. The County may waive or modify this requirement for redevelopment sites that originally incorporated BMPs for stormwater runoff quality control, provided the following provisions are satisfied:
 - a. In no case may the post-development non-point source pollution runoff load exceed the pre-development load;
 - b. Runoff pollution loads must have been calculated and the BMPs selected for the expressed purpose of controlling nonpoint source pollution;
 - c. If BMPs are structural, evidence shall be provided that facilities are currently in good working order and performing at the design levels of service. A review of both the original structural design and maintenance plans may be required to verify this provision. A new maintenance agreement may be required to ensure compliance with this ordinance.
 - d. For redevelopment, both the pre- and post-development loadings shall be calculated by the same procedures. However, where the design data is available, the original post-development nonpoint source pollution loadings can be substituted for the existing development loadings.

- B. Exclusions

1. Land development projects that disturb less than one acre of land.
2. Linear development projects (e.g. construction of power, communication, or other utility lines; and highway construction projects), provided that (a) less than

one acre of land will be disturbed per outfall or watershed,(b) there will be insignificant increases in peak flow rates, and (c) there are no existing or anticipated flooding or erosion problems downstream of the discharge point.

C. Reference Documents

The Virginia Stormwater Management Handbook shall be utilized for purposes of determining the applicability, pollutant removal efficiency and design guidelines, not specifically contained within this manual, for various BMP measures. Alternative design methods shall require approval by the Director. The Director shall maintain a list of acceptable structural BMP devices and their pollutant removal efficiency.

D. Design Criteria

1. The method used to determine Water Quality Volume (WQV) shall be based on the proposed land uses contributing runoff to the BMP facility, in accordance with the Virginia Stormwater Management Handbook.
2. Water quality inlets are acceptable as the primary control only where there are constraints which prohibit use of other structural BMP devices.
3. BMP measures that incorporate extended detention shall be designed to release the WQV over a minimum time of 30-hours.
4. The County encourages the use of nonstructural BMP measures alone or in combination with structural BMPs in order to meet water quality goals. Such measures help reduce the effects of new impervious cover, thereby reducing the need for structural BMPs. Acceptable measures are identified in the Virginia Stormwater Management Handbook.
5. In order to apply stormwater pollutant removal credit to sheet flow directed to a vegetated area, the area must meet the requirements for a “vegetated filter strip” as defined in the Virginia Stormwater Management Handbook. In such an application, the entire vegetated filter strip shall be located within an easement that ensures the protection of the water quality BMP.

6. Non-Structural BMPs

Non-structural measures may be used in conjunction with or in place of structural measures in order to satisfy the requirements of this section, as provided herein:

- a. The County encourages alternative non-structural measures to satisfy, partially or in whole, the requirements of this section, if such measures are identified in accepted technical literature, are acceptable to the County based on its exercise of sound professional judgment, and the County determines that the measures achieve equivalent benefit for water quantity and/or quality protection in accordance with the Virginia Stormwater Management Handbook’s technology and performance based standards.

- b. Non-structural measures include, but are not limited to, minimization of impervious surfaces, preservation of existing stream buffers, stream buffer reforestation, providing additional stream buffer areas, wetland restoration, and development design that reduces the rate and volume of runoff.

7. Reservoir Protection Requirements

- a. All development shall provide a minimum 300-foot separation from the existing or planned shoreline of the impoundment area of any public drinking water reservoir to any land disturbing activity, provided that this paragraph shall not apply to improvements to the reservoir facilities.
- b. All development within the Goose Creek Reservoir Protection Area, as defined as an area within a five (5) mile radius upstream of the dam must adhere to the following standards:
 - i. At the time of submission of the first preliminary plat for a project to be developed in multiple phases or sections, a conceptual stormwater management plan shall be submitted outlining proposed water quantity and water quality facilities. The purpose of the plan is to ensure a comprehensive approach to managing runoff from the property is achieved.
 - ii. The post-development nonpoint source pollutant load shall not exceed the pre-development pollutant load based upon an average land cover condition of 10 percent impervious cover.
 - iii. In no event shall less than 75% native plant materials be used for vegetated water quantity and water quality facilities.
 - iv. All storm drainage inlet structures shall be marked to indicate that they drain to the drinking water supply and that no dumping into such inlet structures is permitted.
 - v. All erosion and sediment control practices must adhere to Chapter 1220 of the Codified Ordinances of Loudoun County, Chapter 7 of this manual, and the latest edition of the Virginia Erosion and Sediment Control Handbook. In addition, the following more protective measures apply:
 - a) Super silt fence will be substituted for silt fence in all perimeter locations.
 - b) Sediment traps and basins will provide double the minimum required volume (286 cubic yards per acre), except that this

volume may be reduced to avoid impacts to sensitive environmental features (e.g., streams, wetlands, forest cover, steep slopes).

- c) The use of stabilization matting will be expanded to aid in establishment of vegetation.
- d) Development phasing should be utilized to avoid extensive areas of disturbance for extended periods of time.

E. Particular Uses

1. **HOTSPOTS.** A stormwater hotspot is defined as a land use or activity that generates higher concentrations of hydrocarbons, trace metals or toxicants than are found in typical stormwater runoff. A greater level of stormwater treatment may be needed at hotspot sites to prevent pollutant wash off after construction. This may involve preparing and implementing stormwater pollution prevention measures that reduce the generation of pollutants by preventing contact with rainfall.

The following land uses and activities are examples of such hotspots:

- a. vehicle salvage yards and vehicle recycling facilities
- b. vehicle service and vehicle maintenance facilities
- c. vehicle and equipment cleaning facilities
- d. fleet storage areas (bus, truck, etc.)
- e. industrial sites
- f. marinas (service and maintenance)
- g. outdoor liquid container storage
- h. outdoor loading/unloading facilities
- i. public works storage areas
- j. facilities that generate or store hazardous materials
- k. commercial container nursery
- l. golf courses
- m. storing and dispensing of petroleum products
- n. chemical storage
- o. sale or transfer of contaminants
- p. dry cleaning operations

2. A stormwater pollution prevention plan implementation is required for these land uses or activities under the EPA National Pollutant Discharge Elimination System (NPDES) stormwater program.

3. Golf Courses.

Notwithstanding the requirements for a site plan as contained in the Zoning Ordinance and Land Subdivision and Development Ordinance, where no structures are proposed, construction plans and profiles may serve as a site plan. In addition to other BMP measure requirements provided in this section, golf courses shall meet the following performance standards:

- a. Managed turf shall be reduced by including areas of rough devoted to native plants, natural environments and wildlife habitat enhancement;
- b. An Integrated Pest Management and nutrient management plan shall be submitted for review and approval;
- c. Native or naturalized landscaping shall be used to the extent possible;
- d. Natural vegetation and trees along streams shall be retained to the extent possible.
- e. Stream crossings shall be minimized;
- f. Irrigation, drainage and retention systems shall be designed to provide for efficient use of water and the protection of water quality;
- g. Water reuse strategies shall be employed when feasible;
- h. Participation in the Audubon Cooperative Sanctuary Program is encouraged; and
- i. Adherence to the "Environmental Principals of Golf Courses in the United States", published by the Center for Resource Management is encouraged.

4. Petroleum Products and Hazardous Substances

In order to adequately protect surface water and groundwater quality, land uses and activities that propose storing, handling and/or dispensing petroleum products and hazardous substances shall meet the following standards:

- a. Oil/water separators shall be required for all facilities that engage in activities (other than agricultural) that potentially generate oily wastewater, including but, not limited to, vehicle maintenance/washing/detailing, fuel storage/dispensing, and machine and paint shops. When available, the discharge shall be to the LCSA sanitary sewer. If this is not available and the discharge must be to the storm sewer, a Virginia Pollutant Discharge Elimination System (VPDES) permit will be required. Design and pretreatment standards shall be in accordance with the Codified Ordinances of Loudoun County

and the LCSA Guidelines.

- b. Secondary containment shall be required for activities that propose storing, handling and/or dispensing of petroleum products (except for liquefied petroleum gas) and hazardous substances. The secondary containment shall be designed to provide a means of detecting material loss from the primary container; sufficient/compatible containment of the loss; retrieving the loss; and correcting the deficiency. For groups of tanks/containers, the secondary containment must be able to hold the contents of the largest container plus precipitation (if there is no roof). Temporary secondary containment shall be provided for construction sites that use petroleum products or hazardous substances.
- c. The applicant shall provide evidence that an approved Emergency Response Plan has been filed with and approved by the Loudoun County Department of Fire and Rescue Services.

5.400 FLOODPLAINS

A. Definitions:

1. Base Flood: The flood having a one (1) percent chance of being equaled or exceeded in any given year. Also known as the 100-year flood.
2. Floodplain: Any land area susceptible to being inundated by water from the base flood and having a drainage area greater than one hundred (100) acres. For the purposes of this chapter, a distinction is made between floodplains in watersheds of greater than 640 acres (major floodplain), and those in watersheds of 640 acres or less (minor floodplain). In areas where a major floodplain overlaps a minor floodplain, the regulatory floodplain limits (major and minor) shall be established as the maximum computed or published floodwater elevation for any given point along the channel. The boundary line between the major and the minor floodplain may be defined as either: the intersection of the County approved backwater profile of the base stream and the County approved headwater profile for the tributary stream, or, where a detailed study of the tributary has not been performed, the boundary as shown on the Floodplain Map of Loudoun County.
3. Alteration: A development action which will change the cross section of the floodplain and will increase either the erosive velocity or height of floodwaters either on-site or off-site. Alterations include, but are not limited to, land disturbing activities such as clearing, grading, excavating, transportation improvements and filling of land.
4. Cross section: Shape and dimensions of a channel and valley of the floodplain perpendicular to the line of flow.

- B. The following types of floodplain applications are used within the land development process and should be submitted to the Director. Refer to Chapter 8 of this manual for the specific requirements of each application type.
1. Floodplain Study Waiver shall be submitted prior to or concurrent with submission of construction plans and profiles or site plan application.
 2. Detailed Floodplain Study shall be submitted prior to or concurrent with submission of construction plans and profiles or site plan application.
 3. Floodplain Alteration, Type I shall be submitted and approved prior to issuance of a Zoning Permit.
 4. Floodplain Alteration, Type II shall require review and approval prior to the approval of an associated construction plans and profiles or site plan application.
- C. Floodplain Mapping
1. The County floodplain maps shall be updated upon the presentation of appropriate topographic information. This information shall be in a form acceptable to the County to facilitate a map update.
 2. Loudoun County is a participating community in the Federal Emergency Management Agency's (FEMA) National Flood Insurance Program (NFIP). As such, the County is required to coordinate the submission of more detailed technical information to FEMA for periodic updates of the Flood Insurance Rate Maps. A FEMA revision shall be required in accordance with the current Federal Emergency Management Agency "National Flood Insurance Program and Related Regulations". A FEMA map revision will be required when a Floodplain Study or Alteration affects the FEMA-defined Special Flood Hazard Area (SFHA).
 3. The submission of such information to FEMA shall be required prior to approval of the floodplain study or alteration, when appropriate. FEMA must approve the Letter of Map Revision (LOMR) prior to bond release for the related construction plans and profiles or site plan application.

5.410 FLOODPLAIN STUDY WAIVER

A Floodplain Study Waiver request may be filed with the Director primarily for subdivisions of land zoned AR-1, AR-2, A-3, A-10, JLMA-20, and TR-10 provided road crossings or other encroachments of floodplains are not proposed. Waivers may also be granted in other Zoning Districts for projects which do not propose crossings or encroachments in the floodplain and where existing floodplain information reflects ultimate development conditions.

5.420 DETAILED FLOODPLAIN STUDIES

Detailed floodplain studies performed to meet the requirements of the floodplain overlay district within the Loudoun County Zoning Ordinance shall be required for review and approval concurrent with the associated construction plans and profiles or site plan application and shall include information required in Chapter 8 of this manual. The study shall be prepared in accordance with the following requirements:

A. General

1. Detailed floodplain studies shall be based on the runoff from a 24-hour 100-year rainfall depth. Flows will be determined utilizing methods discussed in this chapter.
2. If the floodplain study is located within the FEMA-defined SFHA, it must be based on either the runoff from a 100-year rainfall depth as described in this chapter or the regulatory FEMA flow rate, whichever is larger.
3. Water-surface elevations should be determined by the standard step method. HEC-2 and HEC-RAS models are acceptable. Alternative methodologies must include a description of the method assumptions, limitations, and a program users manual. Alternative methodologies must be approved by the Director prior to use.
4. Model input parameters will be determined based on physical properties of the watershed and stream valley using good engineering judgment and are subject to the Director's approval. Input parameters shall include the starting water-surface elevation determined by either the normal depth (slope area method), a known water-surface elevation, or by other approximation methods acceptable to the Director and roughness coefficients to reflect channel and overbank conditions.
5. If a FEMA Flood Insurance Rate Map revision is required, then the model must be acceptable to FEMA.

B. Cross-Section Selection and Location

1. Location of cross-sections shall be selected based on two (2) foot contour interval topography and any existing and/or proposed channel improvements and road crossings. Cross-sections are needed at floodplain contractions, expansions, sharp changes in invert slope, and where abrupt changes in channel roughness occur.
2. Cross-sections should be as nearly perpendicular to floodplain flow as possible and should be identified using a topographic survey. The base line

should be located as closely as possible to the center of the major conveyance area. Distances along the base line between sections should not exceed 300 feet. Location of cross-sections is subject to Director's approval.

- C. If the floodplain study is being prepared for a particular site or property, the detailed floodplain study shall extend a minimum of 300 feet upstream and downstream from the particular site or property. The floodplain study prepared shall be shown to be compatible with other floodplain studies within 1000 feet along the affected stream of the study area.

5.430 DETAILED FLOODPLAIN STUDIES CONDUCTED WITHIN THE BROAD RUN WATERSHED

The flow values and water surface elevation from "The Floodplain Study of the Broad Run Watershed" shall be used as the regulatory floodplain from the main stem of Broad Run. The main stem starts at the Potomac River and runs to the confluence with the North and South Fork of Broad Run. Floodplain studies for the tributaries to Broad Run shall use ultimate development conditions and include standard requirements for detailed floodplain studies. The following additional requirements also apply so that the study may be compared to "The Floodplain Study of the Broad Run Watershed".

A. Hydrology

1. The 100-year flow values used to define the regulatory floodplain along the main channel of Broad Run shall be taken from "The Floodplain Study of the Broad Run Watershed".
2. The 100-year flow values to be used for the tributaries to Broad Run shall be generated from a detailed hydrologic analysis subject to the following requirements:
 - a. The land use assumptions will be based on the planned land use as depicted in the approved comprehensive plans, or approved rezonings. Hydrologic parameters shall be based on the most current adopted planned land use for the watershed.
 - b. The flow shall be calculated utilizing either the Natural Resources Conservation Service TR-20 model or the Corps of Engineers HEC-HMS or HEC-1 model. TR-55 will be considered with prior approval from the Director.
 - c. The hydrologic cross section locations and subbasin delineations shall be derived from the Broad Run watershed maps. Additional routing sections, reservoir routings, or subbasin delineation may be included as necessary. HEC-1 models shall utilize modified subbasin delineations

which have times of concentration values in compliance with $T < 0.29$ lag time criteria.

- d. The hydrologic analysis shall begin with an original subbasin outfall and shall be numbered in accordance with the numbering system used in "The Floodplain Study of the Broad Run Watershed".

B. Hydraulics

1. Land Development applications which contain floodplain associated with the main stem of Broad Run and which have a hydraulic cross section located within the construction limits of the project shall include the following information. This information will replace the floodplain study requirement outlined in this Section. This information will be required concurrent with a Construction Plan and Profile application or a final site plan application.
 - a. Hydraulic cross sections used in "The Floodplain Study of the Broad Run Watershed" shall be verified with updated 2-foot contour interval topography or field surveyed information. The methods of verification shall be provided. Additional cross sections may be required by the Director as determined by site specific channel characteristics.
 - b. The Mannings "n" values as used in the HEC-2 study shall be verified. Methods of verification shall be included in the report.
 - c. The land development application shall include cross sections which would show both the regulatory floodplain elevation, the flood protection elevation, and the ground elevation.
 - d. The land development application shall include a plan view of the area with cross sections denoting the flood protection elevations.
2. Floodplain Studies for the tributaries to Broad Run shall use the fundamental hydraulic requirements outlined in this chapter and incorporate the following requirements:
 - a. The hydraulic cross section locations will correspond to the cross section locations used in "The Floodplain Study of the Broad Run Watershed". Additional cross sections shall be provided every 300 feet or as necessary to accurately reflect conveyance conditions in the channel and overbank areas. All cross sections shall be derived from 2-foot contour interval topography or field surveyed information.
 - b. The starting water-surface elevations will be the "ultimate scenario" elevations at the confluence of the tributary with the main stem if the

area of study is within 1000 feet of the main stem. If the study is over 1000 feet from the confluence, the water surface elevation at an existing Broad Run cross-section will be used. If the study is over 1,000 feet from the nearest existing Broad Run cross-section, an approved elevation from another study or a method accepted by the Corps of Engineers may be used.

- c. Hydraulic studies shall begin and end with cross section locations shown in "The Floodplain Study of the Broad Run Watershed".
- d. The hydraulic study shall extend 300 feet off-site or tie into a previously approved study or alteration within 1000 feet.

5.440 FLOODPLAIN ALTERATION WAIVERS

A floodplain alteration waiver request may be filed with the Director for minor encroachments and alterations, which shall include minor alterations to previously approved Floodplain Alteration applications. Such a request shall include a statement of the proposed development project, justification of the waiver requested, and treatment of the floodplain area. The waiver request shall be accompanied with a 1:2400 (1"=200') scale concept plan of the proposed site development and alteration.

The applicant must show that the proposed alteration will have a negligible impact on the floodplain limits, channel configuration, and water surface elevation. Clearing and grading within the floodplain shall be kept to a minimum and shall not be proposed within the main channel of the stream.

A. Major Floodplain

Any proposed construction activity in either a major floodplain or an area designated as a Special Flood Hazard Area (SFHA) on the Loudoun County and Incorporated Areas Flood Insurance Rate Map (FIRM) shall require approval of a Floodplain Alteration or Floodplain Alteration Waiver. SFHA's include those areas designated as Zones A or AE on the Loudoun County FIRM.

B. Minor Floodplain

For the specific construction activities listed below that do not involve offsite construction nor impacts to flooding on offsite property and are located wholly in the minor floodplain, a "Declaration of No Impact to Minor Floodplain" narrative may be submitted in lieu of obtaining a Floodplain Alteration or Floodplain Alteration waiver. Such a narrative shall be included in the general notes of the companion Site plan or Construction Plans and Profiles and describe the work within the minor floodplain. Further, the narrative will provide certification that the construction activity within the minor floodplain will not impact offsite property and will have at most a negligible

impact on floodplain limits, channel configuration, and water-surface elevations.

1. Installation of underground utilities that will return the ground to its existing (i.e., predevelopment) grade.
2. Storm drainage outfall channels.
3. Clearing activities that do not involve changes to the existing grade.
4. Excavation activities where the excavated material is removed in its entirety from the floodplain.

5.450 FLOODPLAIN ALTERATIONS

Floodplain alteration applications shall contain information sufficient to demonstrate conformance with the Loudoun County Zoning Ordinance. Floodplain alteration analysis requirements are divided into Type I and Type II depending on land use and complexity of the proposed alteration. The analysis will extend upstream and downstream to the point where the floodplain limits are restored to the original conditions.

A. Type I Alterations

A Type I floodplain alteration may be submitted separately or as a part of a construction plan and profile application for private driveways serving one residential lot and private access easements as provided for by the Land Subdivision and Development Ordinance. Type I floodplain alteration applications must propose floodplain crossings that conform to the following design standards and must contain the following information:

1. Option 1:

This option shall be used for single lot driveways and shall be comprised of a sketch plan submitted prior to or concurrent with the zoning permit application. The sketch plan shall illustrate the proposed crossing, the dimensions of the proposed culvert or bridge structure and the proposed location. This sketch plan shall be reviewed, revised by the applicant if required and approved by the Director prior to the issuance of the zoning permit to ensure that there will be no off-site degradation as a result of the floodplain encroachment. The sketch plan shall clearly indicate that the alteration will not impact off-site properties. If the sketch plan indicates the alteration may impact off-site properties, the County will require additional information prior to approval.

2. Option 2:

This option may be used for private access easements which serve 2 to 7

individual lots. Sufficient documentation shall be submitted as part of or concurrent with the construction plan application to ensure that the crossing conveys channel flow and provides overland relief for the 100-year storm along the approaches to the crossing.

- a. The design shall be configured to convey the 2-year storm or bank full conditions without overtopping the access road.
- b. The profile of the crossing must be such that there is overland relief for the 100-year storm with minimal obstruction. No rise in flood elevations because of the crossing will be allowed beyond the limits of the applicant's property.
- c. All culverts used will conform to this chapter. A minimum of 2 feet of cover is required over all culverts.
- d. Culvert designs and computations shall be in accordance with the VDOT Drainage Manual.
- e. Where it is evident that there are no alternative driveway locations for a particular lot, the construction plans shall include the proposed and engineered driveway location and corresponding culvert computations.

Proposed designs for crossings shall be evaluated by the Director to determine if more detailed engineering is necessary to ensure that there is no potential damage to neighboring property in any direction due to backwater or increased channel velocity. If more engineering detail is necessary, a Type II alteration shall be required.

The Director may consider alternatives to the above requirements (i.e., low-flow crossings) if desired by the applicant. In such cases, however, the record plat shall provide a note disclosing the flooding potential of the access easement.

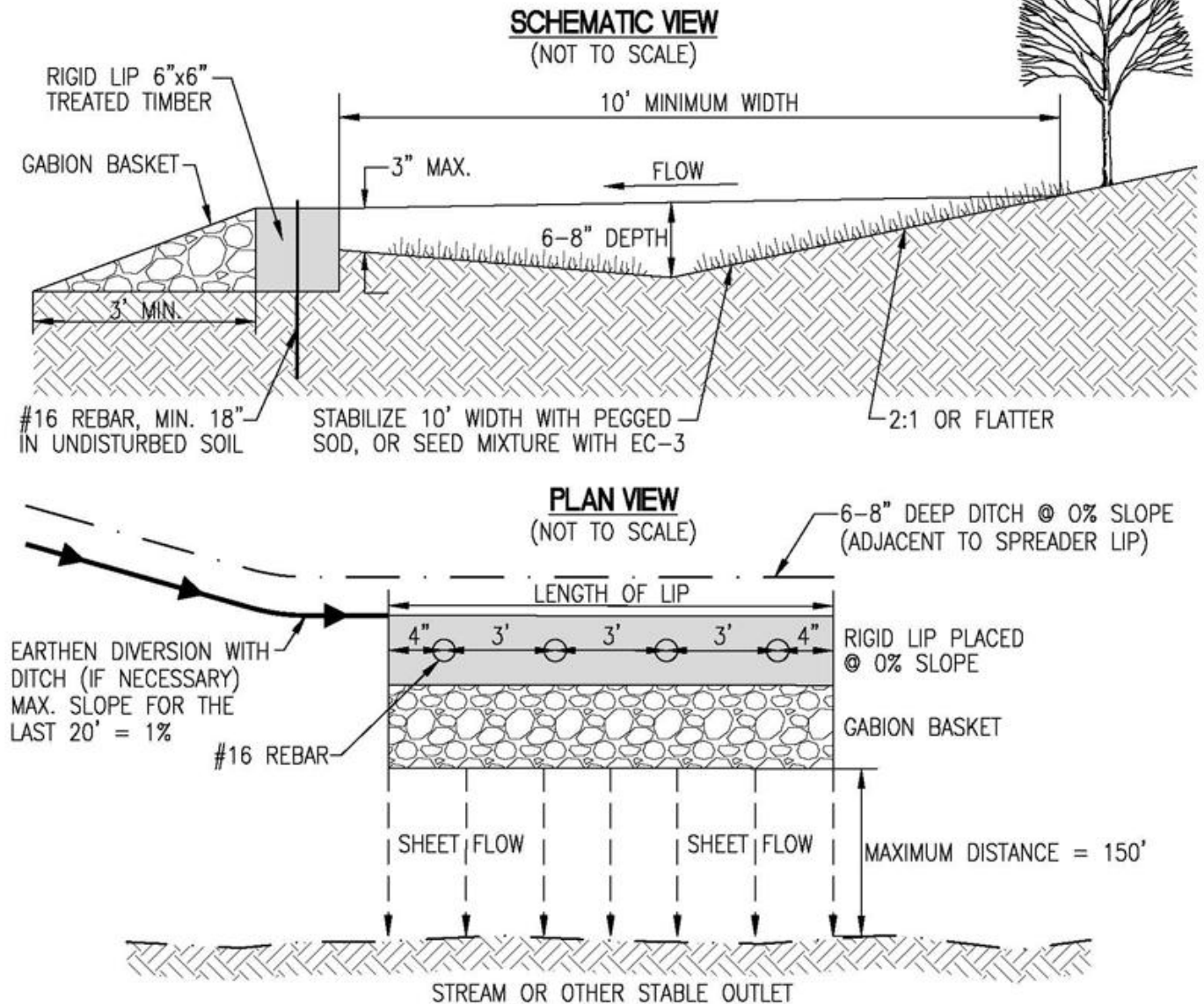
B. Type II Alterations

Type II floodplain alteration applications must be submitted for any alteration which has a significant impact on channel configuration, water surface elevations, and/or floodplain limits and all other cases not included in A above.

The Type II floodplain alteration will conform with the requirements in Detailed Floodplain Studies, and will be based on an approved detailed floodplain study. Refer to Chapter 8 of this manual for detailed requirements associated with the Type II floodplain alteration studies.

SIMPLE LEVEL SPREADER (15 CFS MAXIMUM)

FIGURE 1

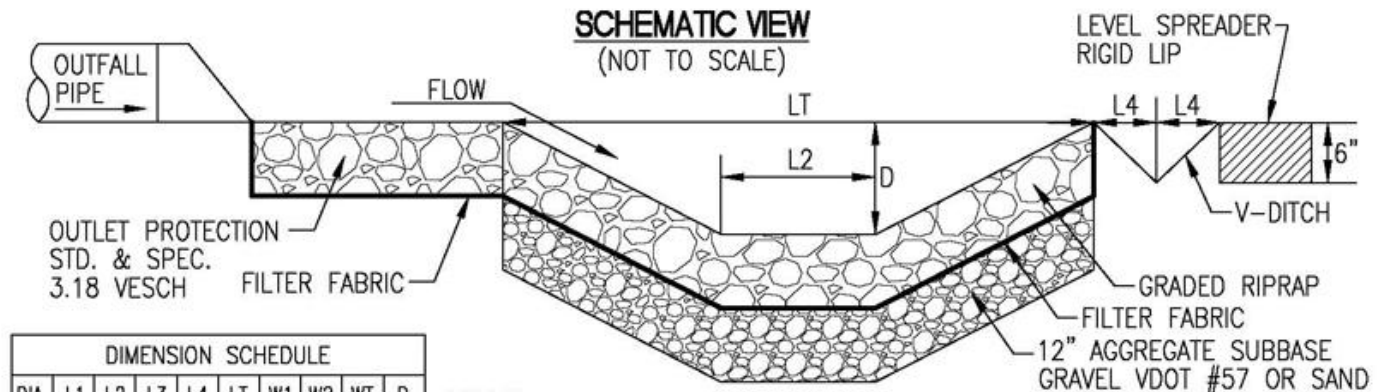


NOTES:

1. LENGTH OF RIGID LIP (6"x6" TREATED TIMBER) = 2x10-YEAR DISCHARGE, WITH A MINIMUM LENGTH OF 10'.
2. A CONCRETE CURB WITH A MINIMUM 3' FOOTING IS AN ACCEPTABLE SUBSTITUTE FOR TREATED TIMBER RIGID LIP.
3. THE GABION BASKET, CONSISTING OF VDOT #1 OPEN GRADED COARSE AGGREGATE IN GALVANIZED WIRE MESH, SHALL BE SECURED TO THE RIGID LIP.
4. MAINTENANCE REQUIREMENTS:
 - A. DOWNSTREAM SLOPE SHALL BE INSPECTED FOR RILLS. IF RILLS EXIST, INCREASE LENGTH OF RIGID LIP AND/OR EMPLOY ADDITIONAL STABILIZATION MEASURES ON THE SLOPE.
 - B. AFTER A FREEZE-THAW CYCLE, INSPECT LEVEL SPREADER TO ENSURE HEAVING HAS NOT OCCURRED. CORRECT ANY DISPLACEMENT IMMEDIATELY.
 - C. IF SEDIMENT DEPOSITION OCCURS IN THE DEPRESSION, IT SHALL BE REMOVED WHEN MEASURE LOOSES 1/3 OF IT'S VOLUME.

LEVEL SPREADER WITH PLUNGE POOL (35 CFS MAXIMUM)

FIGURE 2



DIMENSION SCHEDULE										
DIA.	L1	L2	L3	L4	LT	W1	W2	WT	D	
15"	2'	2'	2'	1'	6'	2'	2'	6'	1'	
18"	3'	2'	3'	1'	8'	3'	2'	8'	1'	
24"	3'	2'	3'	1'	8'	3'	2'	8'	1'	
30"	4'	2'	4'	1'	10'	4'	2'	10'	2'	

NOTES:

1. RIPRAP SIZE SHALL BE BASED UPON OUTLET VELOCITY AS PER FSM 5.220.B.14.
2. RIPRAP THICKNESS SHALL BE BASED UPON STD. & SPEC. 3.18 IN THE VESCH.
3. FILTER FABRIC MUST BE PERMEABLE AND MEET THE REQUIREMENTS FOUND IN STD. & SPEC. 3.19 IN THE VESCH.
4. CONSTRUCTION MATERIALS AND DESIGN LENGTH FOR LEVEL SPREADER RIGID LIP SHALL BE CONSISTENT WITH FIGURE 1, "SIMPLE LEVEL SPREADER."

